RECOMMENDATIONS FOR BSC. AND MSC. THESES WRITING AT THE INSTITUTE OF CHEMISTRY, FACULTY OF SCIENCE, UNIVERSITY OF SOUTH BOHEMIA

Dear students,

as you have arrived at this point of your studies, where you are reading these instructions, there is a great probability you are successfully heading towards the state exams to which also belongs the defence of your thesis. It is of course in your own interest to do well – first for your own feeling of satisfaction, for your family and friends but also for another good reason. You want to get a good job in the future, and a high-quality bachelor or master's degree thesis can help you get one.

Apart from your personal reasons, do not forget that your work also represents your department and faculty and should compare well in the eyes of other colleagues and institutions. Poor quality work can and will, therefore, be evaluated with a lower grade or even failed during the defence procedure. Instructions written below should be helpful to your writing regarding both form and graphics.

Both your practical work and the written thesis will require a good knowledge of the research area, and it is therefore important that you study scientific literature written on your topic from the beginning. Knowing both the background and state of current knowledge will help you to plan your experiments (and not repeat experiments already done and published), to understand your results and above all to write your thesis with the required quality. During the defence of your thesis you will have to persuade the opponent(s) and the committee that you have understood the topic, you can explain your results well, and you have reached correct conclusions.

Last but not least, why do we bother you with these instructions? It could seem to you that your fine results are the most important and the writing itself does not matter. However, your thesis must show that the results are good, and you can do that only by writing a comprehensive report about it – it is the thesis that will be read and remembered, and that will remain in the records. Furthermore, many of you will continue doing scientific work, and here you have your first opportunity to learn how to report your research correctly.

Yet one more thing – these instructions are not complete; there is extensive literature out there on this topic. Take these instructions as the basic information, ask for help also your supervisor and colleagues from your laboratory, and find some more information on the web or in the Library (we have several books on this topic at the Institute as well).

1 Assignment of bachelor's and master's degree thesis

The length of a standard bachelor's degree is three years, two for master's degree (two and half years for Biological Chemistry master's program). This length is sufficient for the studies themselves, but if you are to work experimentally on your thesis, your time may be limited. It is therefore important that you decide on the topic of your thesis early in your studies and start to work with your supervisor as soon as possible. Predicting complications and their nature in research is nearly impossible, but they can appear at any time, whether in the form of malfunctioning experiment or flooded laboratory. If you get your results ready a year before finishing your degree, you will have sufficient time for the writing itself. And other well-meant

advice – if you want to produce a thesis of high quality, writing it must be granted enough of your time - in the range of several months, definitely not a couple of weeks. Anybody telling you otherwise does not know what he is talking about, or he has had excessive help.

Posted on the web pages of our Institute you will find a list of possible thesis topics that we recommend; additional topics can be found on the Faculty webpage. Furthermore, the Orientation Seminar with a list of offered theses is organised for some time now at the beginning of the second semester. You can get more information at the respective supervisor, in our department, other faculty departments, the Academy or other. After deciding on a topic and after agreement with the supervisor, you need to fill out a form of thesis assignment – possible to download from department web pages – that needs to be signed by you, the supervisor and the head of the department. Finally, you are to take it to the Dept. of Study Affairs for filing. First, then are you officially working on your thesis.

To sum up, you should pick your thesis topics during the second year of your bachelor and the first year of your master studies the latest, you should start with your work the coming term and have most of your results ready six months or even a year before it is due. Also, when choosing a topic, do not forget your line of study which should be at least partly connected.

Attention! If you will not work satisfactorily, your supervisor is allowed NOT to credit your work – which can lead to termination of your study.

2 The form of thesis work

2.1 Work structure and extent

We recommend the following structure of your thesis:

Title page and introducing pages (further information can be found in the Provision of the Vice-Dean No. 1)
Abstract or summary – in Czech and English
Keywords – not compulsory
Content
Introduction (or Theoretical part)
Work aim(s) (can follow or precede the Introduction)
Material and methods
Results
Discussion
Conclusion
References/Literature/List of used sources
List of used abbreviations and symbols – can be placed above the introduction
List of Appendixes – in case the work includes these
Appendixes – not compulsory

A similar structure (excluding introductory pages) is required in most scientific journals.

Chapters, units and subunits should be numbered; no full stop follows the final number.
Example:

1 Introduction

1.1 House mouse
1.1.1 Physiology of the house mouse
1.2 Rodenticides used in households

The extent of your thesis should be adequate – Introduction should include all important information considering the thesis, in Material and methods all used techniques, chemicals and other material must be stated and described, Results chapter should give an overview of all important results that are later compared or discussed suitably in Discussion. You should at the same time avoid dead weight in the form of unnecessary, unimportant information. Filling up space with extra-large figures, tables and so on is also unsuitable. The theoretical part in experimental theses should comprise about one-third of the whole text which should contain at least 18 A4 pages for bachelor thesis (rarely than 50 pages) and at least 25 A4 pages for master's thesis (rarely more than 60 pages).

2.2 Page dimensions, indentations, etc.

Basic information on the format, sizing, etc. can be found in the Provision of the Vice-Dean No. 1

Distinguish the decimal sign in Czech (German) and English text (comma versus dot). Do not leave single words on a line or single sentence or heading on a different page. For further punctuation rules use some unified style. Most important is to keep to one chosen style and follow the same rules throughout the text.

Besides the same punctuation style, other unifications are necessary for the resulting thesis to "look good". To these belong keeping the same font style and sizes, same indentations or same table and figure style. Furthermore, tables and graphs should be correctly placed and compiled. Grammar and spelling should be checked, preferably directly in the word processing program used, such as in MS Word. Also, check the correct spelling of the Latin scientific names (both the genus and species name should be written in italic style such as *Homo sapiens*).

Finally, the scientific text should be written using the passive verb form.

2.3 Title page and introducing pages

Your thesis can be bound into hardcover, thermocover or spiral binding. You can get the information on the appearance, form and content of the cover and the title page as well as the data required on the pages preceding the Content, and about the "Declaration" in the Provision of the Vice-Dean No. 1. Up-to-date information on the number of submitted copies and the copy types can be found on the Institute webpage.

2.4 Introduction

In the Introduction chapter, known information and background connected to your thesis should be drawn. Only relevant information should be given. For instance, if working with a living organism, it is exaggerated to start with a description of the cell structure and evolution of life, it is sufficient to describe the organism itself regarding its genus and species name. Therefore, only the summary of theoretical facts that you have learnt and worked further with

should comprise this chapter. Also, consider the fact that other students will probably read your thesis in the future and your introduction if well written may be the basis of their knowledge about the subject.

Introduction or research summary should be logically structured. When studying the interaction of a substance and a particular organism, first the organism then the studied substance should be shortly described, followed by a description of the method used to study that interaction and so on. Logical continuity should apply throughout the text as a whole, in the individual paragraphs as well as in sentences. In Introduction, information from studies already published and from highly relevant sources should be used. By relevant we mean research publication, a scientific paper describing the original study, NOT a ternary source such as a dictionary, popular science literature or Wikipedia. Using such sources will directly lead to a **FAILED** classification of your thesis. Also, let it be stated here and now that writing an Introduction requires citations, your introduction must be based on published facts and data and every time you use information from a source you have to reference it, or you are committing a crime called plagiarism (see below).

Scientific language correct technical terminology and formal style must be used in the introduction and throughout the text. Writing a meaningful and comprehensive introduction is maybe somewhat surprisingly particularly difficult and thinking that you will concentrate on your results and the conclusion while the introduction will almost write itself, in the end, is quite foolish. Instead, take your time studying and summing up the background knowledge and put enough effort into your writing.

Plagiarism

When writing a scientific text, you must be extremely careful to avoid plagiarism – breaking the ethical rules of referencing and citing the scientific work of others. To use the words, results or knowledge of somebody else without a citation is actually illegal and a cause of **disciplinary proceedings** at the department. It is at the same time a cause for **failing** the student who has done so for the defence as this proves him both lazy and unable to comprehend and use basic information. Furthermore, plagiarism revealed after a successful defence is still a crime and can be treated as such.

What is and is not plagiarism and how does referencing work?

The word citation is used for two different things. The first means that you cite – literarily copy somebody else´s writing. In this case, you need to use the citation sign, italic text and you, of course, need to give the author and the source. Such a citation should not be longer than four lines or 50 words. Writing the whole text, or even its major part, of Introduction combining different citations, is not permissible and will lead to a lower grade for your work.

The second meaning of citation is paraphrasing or rewriting the ideas of others. This means that you take one or two sentences, paragraphs or even the entire work of somebody else, and you restate and rewrite them in your own words – THIS is the usual way scientific texts are prepared. You, of course, need to reference the original work.

It is also important for you to realize that you must cite your own older work as well and not copy already published work thus committing self-plagiarism. Yet another form of plagiarism is translating of a text from another language word-for-word (sentence-for-sentence).

In some cases, no source needs to be given without any danger of committing plagiarism. This applies in the case when you are saying something well-known or generally understood such as the fact that genetic information is coded by DNA.

Citing other works

How do you reference cited source in your text? There are two possible options – either you give the citation a number, or you give the name of the author(s) and publishing year. In both cases, the full citation must be given in the Reference/ Literature chapter. Such reference is usually placed at the end of a sentence or paragraph and being a part of that sentence is followed by a full stop. If several pieces of information are given in one sentence, they can be either referenced together at the end of the sentence or placed individually where relevant.

If you decide to use numbered citations, start with number 1 for the first citation used in the text, followed by number 2, 3 and so on, while in the Literature chapter full citation corresponding to the number used in the text is found. Another possibility, although not that often used in natural sciences is to write each citation as a footnote.

Examples of numbered citations in the text*: In the following years, new mutations have been found for the CYP2D6 gene (1,2)*. Or: … *CYP2D6 gene [1,2]. Or: … CYP2D6 gene*[1,2].

The second case named above is used most often, especially in biological sciences. Here, you give the name of the author and the year when the work was published in brackets (if there is only one author), first and the second author followed by the year (if there are two authors). If more than two authors exist, use the name of the first followed by the abbreviation *et al.* and then the year. In this case, the references are ordered alphabetically by the name of the first author and other authors or the publishing year in case of similarities.

Examples:

One author: The currently observed climatic changes have caused an altered spread distribution of the ticks (Eisen 2008).

Two authors: *O*-glycans are differentially expressed in different life stages as was shown in *Drosophila* (Tian and Hagen 2006, 2007).

Or: … in *Drosophila* (Tian & Hagen 2006, 2007).

Or: … in *Drosophila* (Tian *et* Hagen 2006, 2007).

Three and more authors: Protein expression has been compared for ticks *Ixodes ricinus* infected and non-infected by the spirochete *Borrelia burgdorferi* (Rudenko *et al*. 2005).

In case the information given in one sentence has several sources, you can reference them together either by increasing numbers or by alphabetically ordering the names of the first authors.

If more than one publication was accomplished by the same team of authors in one year, you must distinguish them by a letter

Example: … *burgdorferi* (Rudenko *et al.* 2005a).

As an exception, a web page can be referenced as the source. In this case, the web address is given in parenthesis. Be careful with the form of the web page. The reference can often be several lines long. It is sufficient to give the main page or such address that will make it possible for another person to reach the required information. And once more – web pages are cited only exceptionally.

Another important issue is – Where to find the sources of information we have been talking about? Your first choice should be the academic library where relevant books and scientific papers are kept and collected. If the information found is not enough up to date or thorough enough, you have to look into the scientific databases. The classical and most often used are Web of Science, PubMed, Scopus or Google Scholar. Many papers are available free of charge, in many cases, the library has prepaid access. If you run into problems and cannot get to an

important paper, you can ask either the librarian or your supervisor for help. You can also use qualification work of your fellow students, also often found in the library or online (only in cases, when you are citing such a work because of its results, NOT to get general information from the Introduction section).

It is important to maintain the same citation style throughout your paper, not only in Introduction but also in Materials and methods, Results and Discussion chapters. In general, you should use the citation style most often used in your line of research. If your paper is chemical (biochemistry belongs to biological subjects, though) you should check chemistry journals and follow their style. Molecular sciences (biochemistry, molecular biology, biophysics and so on) have their own citation style as do zoology, botanic or mathematics. Your supervisor will help you with the decision on the citation style.

Introduction chapter can be followed by Work aims (in points) and then the Materials and methods chapter.

2.5 Materials and methods

In this chapter all material, chemicals etc. that you have used must be given so that your experiments can be repeated. Next, all the methods used to get your results should be given and described. It is important to think about the fact that the extent to which you describe chemicals and instruments used depends on the scientific field. While sometimes a detailed description of every chemical is necessary together with all specifications and producer names, only special chemicals are mentioned in other fields. The same applies to instruments. Your supervisor will help you here.

Methods used should be described succinctly but sufficiently. Formulations such as “I have isolated DNA with XY kit (product of ZZ) according to the specifications” are unsuitable.

2.6 Results and discussion

Results and discussion are here described together due to one simple reason – it is done so in some scientific areas of research, or it is more convenient for some type of work. If you will or will not unify these two or separate them into individual chapters should be the result of a discussion between you and your supervisor. You should consider it very carefully as a combination of these two chapters into one is much more complicated even though it does not seem to be – authors in such a case usually “forget” to discuss their results.

Regarding the Results – notice and think about what this title means and implies. Under heading Results, all your results should be shown. A graph, table or description of a result does belong to neither Methods or Discussion, only to this chapter named Results.

All your results must be described in the text, a graph is not enough by itself - it must be explained as well. A formulation such as: “The way my plants have grown is shown in Table 3” is not suitable. Neither can you write “This is the way my plants have grown, the rest is explained in the text” as a caption to a graph or figure.

All relevant results should be shown – relevant as to relating to the assignment and the resulting conclusion of your work. You do not have to, or even mustn´t show all your graphs, photos or pictures of all your gels, plants, seeds or bacteria. Only the most important or relevant figures should be published here. Less interesting or relevant data or extensive tables and pictures can if you still want them shown, be attached as Appendix at the end of your work. This section is not here to persuade your opponent or the committee that you have been working hard

and have many results. Instead, it is the chapter where you introduce your results, that you later discuss and based on which you reach your conclusions. Remember – the opponent and other readers will evaluate your work also based on your results – thus, included some satisfactory amount of results. If the work contains only two information-less tables, graphs, then such a thesis is most probably of low quality.

When describing your results, you should not use your emotions (this is a wonderful picture…, the mouse was very nicely dissected, or the curve kept increasing just as we hoped it would…..) instead your description must be objective and exact. Do not say – the curve was getting bigger and bigger – use numbers, say exactly how large the increase was, how many times or what you can compare the values to.

With increasing availability of modern, but also expensive and complicated instruments, a new problem has been emerging in the theses lately – the students are reporting results they have not participated in obtaining. It is reasonable to use such results, only in case it is reported exactly who performed the measurements, and in case the student understands and can explain the measurement procedure and the obtained results, he/she should also have done or at least witnessed some of the measurements personally.

The discussion serves for comparison of the results and concludes with already known and published information, for putting your results in context with what is already known. If your results are innovative, an explanation must be found and given and then put into context with known facts. If you have created perpetum mobile, you must explain that up to now it was a well-known fact that this is impossible and then you can demand to be given a Nobel price.

In Discussion chapter, you must refer to the papers you have been comparing your work to or where you have been getting information to support your conclusions from. Discussion without references (note the plural form, as one is definitely not enough) is wrong and will get you a "**failed**" on your thesis. Even work on a new, unknown field can be compared to known literature. Many students and supervisors have in the past not paid enough attention to this part of the thesis, even though it is, in fact, the most important chapter. The student has a chance to show and prove - through a discussion and comparison with other published results – that his/her work is relevant and real. A weak and badly conducted discussion chapter makes the whole thesis look weak and badly written, and the evaluation and grade may be accordingly weak.

2.7 Conclusion

If your discussion is longer or in case several results are reported, it is reasonable, to sum up, your findings in short or in bullet points in an individual Conclusions chapter. This chapter is generally recommended as it allows you to sum up your findings in a simple way, without the need for any further showing of results or discussion.

2.8 References/List of used publications

The exact form of the literature section is dependent on the research field – you should, therefore, consult your supervisor and find out what form is typical for yours. What is especially important is to choose one style and keep to it throughout your work. Each form also differs for the reference of a book or an article in a journal and you should check the differences for the particular style you have chosen. Keeping to one style includes consequently either write the full name of the scientific journals or their abbreviations – for instance, Journal of Biological

Chemistry or J. Biol. Chem (or J Biol Chem). For journal names in English, all words always start with a capital letter except for prepositions and connecting words (the same rule applies to the affiliation names - such as departments or faculties). For titles of the cited articles use a capital letter only for the first title word even if capital letters are used for every word in the original text.

Examples of different styles used for the same reference (there are many more…):

Mullis, K.B., Faloona, F.A. 1987. Specific synthesis of DNA *in vitro* via a polymerase-catalysed chain reaction. Methods Enzymol 155, 335-50.

Mullis K.B. & Faloona F.A. (1987) Specific synthesis of DNA *in vitro* via a polymerase-catalysed chain reaction. Methods in Enzymology 155:335-50.

Mullis KB, Faloona FA, 1987, Specific synthesis of DNA *in vitro* via a polymerase-catalysed chain reaction. Methods Enzymol 155, 335-50.

A suitable number of citations for bachelor thesis is 20-30, 40-60 for a master thesis. The newest findings should be given in the text of the thesis; therefore, the references should also be up to date. If a problem was described first in 1995 and new information added in 1998, the newer (or both) source(s) should be cited.

2.9 Graphic style, figures and tables

Figures, graphs and tables should be mainly placed in the Result section. If suitable it is possible to include these in the Introduction or Discussion. Illustrations (figures and graphs) and tables should be numbered separately either in Arabic numbers or Arabic for figures and Roman numbers for tables. Figure captions are always given below, while table description above the object itself. In the caption, the object is usually given in full word, either “Figure” or “Table”, while in the text it is also possible to give an abbreviation when referring to a particular object – for example Fig. 3 or Tab. IV (but check the style in your own field of research also in this case!). Another possibility is to number the objects separately in each chapter, in which case the object is also assigned the number of the chapter (Fig. 3.1, Tab. 4.2). Each figure or table must together with its caption be independently informative. All important information must be given both as the description in the figure and the caption below – or above. This includes significant experimental approach, used names, and description of all samples used or exact standard sizes and types.

In Introduction only figures that can help to clarify the written text should appear. This means that figures of well-known molecules, regular chemical equipment or unnecessary photographs are unsuitable and unnecessary as well as lowering the quality of your scientific work (also gives the impression that the author wants to fill out the pages). Figures should, in general, be in black and white, only exceptionally in colour as in the case of photographs from fluorescence microscopy. For photographs of electrophoretic gels, it is suitable to show the gel in a light colour and the bands of the detected macromolecules in dark colours. This besides saving the printer material also enhances the contrast.

There is one general rule that applies to figures, graphs and tables – all the text must be written in the same language as the text itself. All graphs should throughout the work keep the same size and form, the axes should be chosen to optimize the graph visually - the whole area should be used by the individual graphs, curves or spectra, which should also be specified by

colour, symbol or line type to be easily recognised. Colour lines can be used in some cases, e.g. for results from real-time PCR, FACS, chromatography. Where graphs consist of individually measured points, these must be visible, and in the case of measurement repetition, fault boundaries must be shown as well. DO NOT forget the error bars!

Regarding tables do not forget that it is possible to alter the width and height of the individual squares, change them to take up only the necessary space. Distinguish between zero – actually measured value and the abbreviation N/A (short for Engl. "not applicable" or "no answer") which means that the value has not or could not be measured. Abbreviations or references to the source should for tables be given as footnotes.

Pictures or photographs should be of adequate size, not too large to take up too much space but also not too small to be able to clearly show all necessary details. The font size of text in the figures should be chosen about the final size of the figure. Also, be careful with the resolution of individual figures. If you change the figure using for example Painting application under Windows and add text to the figure in this application be sure the size will not be changed later thus decreasing the quality of the figure. This program saves figures with resolution 96 dpi as a standard and increasing the size of such a figure could make it illegible. Software suitable for figure alteration should, therefore, be preferably used. There are several freeware programs available such as IrfanView.

The last important fact – figures must always be adequately and correctly described with all details visible and specified. Each caption (also regarding graphs and tables) should be precise, short and informative.

These "instructions" on writing your scientific work are rather long, but still, they do not cover all possible problems that might arise or that you can run into. You should therefore continuously discuss and consult your writing with your supervisor or expert supervisor, with your professors or older student colleagues at the department. You may also check older already defended student theses (although you might want to see the verdict of the opponent for the thesis first). Here you might find the inspiration and information you need.